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Preliminary report on an acoustic survey of Inner Placentia Bay, November 1995

by

G. A. Rose

Fisheries Conservation Chair
Fisheries and Marine Institute
Memorial University of Newfoundland
St. John's, Newfoundland
A1C 5R3

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ABSTRACT

An acoustic survey was conducted in Placentia Bay (NAFO 3Ps) with cod as the principal target species in early November 1995. The survey was conducted with two frequency (38 and 120 kHz) Biosonics digital echosounders from the 10 m vessel Innovation (Marine Institute of Memorial University of Newfoundland). The two survey blocks utilized spanned most of the inner part of the Bay. A sub-block, random transect design was used. Analysis employed the new FSIS software developed at Memorial University and CCORE for digital data processing. These techniques enabled bottom and fish resolution much superior to that possible with older and analogue acoustic equipment. Raw densities were converted to absolute using a scaling factor of -32 dB/fish based on previous work. Within sub-block variance was estimated by repeated transect methods, but has not been completed for this preliminary report. Fishing using automatic jigs was conducted at 32 sites. Cod were concentrated over much of the study area at depths of 15-100 m. Densities varied considerably (orders of magnitude). In the west block, densities ranged up to 2 fish/m^2 and biomass was estimated at 8,500 t. In the east block, densities ranged up to 4.7 fish/m^2 and biomass was estimated at 16,000 t. Fish sampled ranged from 37 to 82 cm and 3 to 10 years of age. Most adults were in the early stages of maturation.

RÉSUMÉ

Un relevé acoustique a été effectué dans la baie de Plaisance (sous-division 3Ps de l'OPANO) au début de novembre 1996, visant en particulier la morue. Les échosondeurs numériques Biosonics à deux fréquences (38 et 120 kHz) de l'INNOVATION, navire de 10 m du Marine Institute de la Memorial University of Newfoundland, ont été utilisés à cette fin. Les deux blocs du relevé ont permis de couvrir la plus grande partie de l'arrière-baie grâce à un plan de sous-blocs de transects aléatoires. L'analyse a fait appel au nouveau logiciel FSIS mis au point à la Memorial University, et à CCORE dans le cas des données numériques. La résolution du fond et des poissons ainsi obtenue est supérieure à celle possible avec l'ancien équipement et l'équipement acoustique analogique. Les données brutes sur la densité ont été transformées en données absolues par un facteur d'échelle de -32 dB/poisson, obtenu de travaux antérieurs. La variance intra-sous-bloc a été estimée selon des méthodes de transects répétés, mais n'était pas disponible pour l'inclusion dans le présent rapport préliminaire. Lors de la pêche effectuée à 32 sites à l'aide de turluttes automatiques, la morue était présente en bancs dans presque toute la zone d'étude, à des profondeurs allant de 15 à 100 m. La densité des bancs variait grandement; dans le bloc ouest, elle atteignait jusqu'à 2 poissons/m^2 (biomasse estimative de 8 500 t) et dans le bloc est. jusqu'à 4,7 poissons/m^2 (biomasse estimative de 16 000 t). La longueur des poissons échantillonnés allait de 37 à 82 cm et l'âge, de 3 à 10 ans. La plupart des adultes était aux premiers stades de maturité.

Introduction

Interest in the potential for quantitative acoustic surveys of cod inshore, spatial comparisons with sentinel fishery sites, and the migrational ecology of cod in NAFO Division 3Ps, led to a trial acoustic survey of inner Placentia Bay in February 1995. The survey was planned with co-operation from the local fishermen's committee. The results from this survey indicated a very low density of large cod, and concentrations of smaller cod in deep water, but could be analyzed only qualitatively (relative densities and distributions) because of the new state of the Biosonics digital technology (the results were presented at 1995 NAFO 3Ps assessment meeting). However, the notion that this technology could be used from small boats inshore to survey cod was thought to be sufficiently promising to warrant a second survey at a time when fishermen reported the "migration" of large cod was on, and when further comparisons with the Sentinel fishery could be made. Hence, in November 1995, a second survey was conducted of the inner portion of Placentia Bay using the RV Innovation (30 ft. inshore vessel - Marine Institute). In addition, the recent development of the FSIS analytical package at Memorial University was thought to enable a better resolution of fish and bottom in the difficult inshore environment. Some results are reported here.

Methods

A two frequency (38 and 120 kHz) digital echosounding system (Biosonics Inc.) was deployed from the RV Innovation. Transmitters fired simultaneously at 2 pings/s or 1 ping/s in the deeper waters of the East Block. Survey design employed two large Blocks (termed East and West) which were divided into sub-blocks across the Eastern and Western channels of the Bay each having a N-S distance of 2 and 1 miles, respectively (time precluded a 1 mile grid of the Western Block). Within each sub-block, a randomly placed transect was run across the Block (Figs. 1 and 2).

Resulting digital data at 38 kHz were first viewed with the FSIS species ID software under development at Memorial University of Newfoundland (MUN), then integrated (Fig. 3). This procedure enabled a much more satisfactory removal of extraneous echoes, especially those resulting from bottom and side-lobe echoes, than possible with previous generations of equipment (a major concern when dealing with inshore acoustic data). Raw densities were converted to absolute by a scaling factor of -32 dB/fish (based on the daytime model of Rose and Porter 1995). Biomass was extrapolated by multiplying by the mean weight of fish caught (2.4 kg). No confidence intervals have been calculated because standard methods using the transect means are thought to give relatively meaningless estimates. A method of repeat within-block sampling was attempted during this work but the data have not been worked up yet.

Fishing to procure samples and check species identification was conducted with automatic jiggers at 32 sites. Five small feather hooks were used on each jig in an attempt to decrease gear selectivity. An attempt was made to standardize jigging time - if bottom was struck the

jig was operated for a maximum of 2 minutes or when the standard pull settings responded automatically (note that jigs would often come back with fish before reaching bottom).

Results

Cod were observed with the echosounders at depths of less than approximately 100 m over much of the area surveyed (Fig. 4). Jigging confirmed most acoustic interpretations, although tests could not be conducted at depths much greater than 120 m (no cod caught) (Fig. 5). Few cod were identified on the echosounders at greater depths. Within the depth range of 20-100 m cod were distributed in patches having densities ranging from low (ca. 0.001 fish/m^2) to very high (>1/m^2) and were typically associated with a bathymetric feature (Fig. 4). Any relationships between cod distribution and temperature or other physical phenomena have not yet been examined.

In the West Block, densities ranged up to 2 fish/m^2 and were concentrated at depths of less than 80 m. in several high density aggregations. However, the cod were widely distributed over much of the Block at lower densities (Fig. 1). Based on the mean transect densities, the sum of the 14 sub-Blocks was approximately 8,500 t (Table 1a). Note that the area of highest cod density was also a sentinel fishery site in this area.

In the East Block, densities ranged up to 4.7 fish/m^2 and were concentrated at depths of less than 120 m along the edges of the several Banks and ledges adjacent to the deep Channel (Fig. 2). Based on the mean transect densities, the sum of the 19 sub-blocks was approximately 16,000 t (Table 1b).

Fish sampled ranged from 37 to 82 cm in length and 3 to 10 years of age (Fig. 6). The two strongest components were 5 and 6-year olds (1989 and 1990 year classes), but other year classes were also present. The extent of the size selectivity of the jigging technique used is not known. These fish were in the early stages of a maturing condition. It is evident that Placentia Bay is a highly dynamic area for cod movements, and likely age-specific cod movements, that at present we know little about.

Conclusions

The two inshore surveys conducted in Placentia Bay support the initial contentions of fishermen that cod move annually into the Bay from East to West in mid-October then depart to parts unknown sometime in January. The migration consists of adult fish that presumably spawn in late winter or spring (at locations unknown). The movements of juveniles appears to differ, but the pattern of their movements can at present only be speculative. Acoustic surveying appears to be the superior method to estimate the distribution and abundance of cod in the difficult to survey inshore environment. The development of digital acoustic systems with very high performance (signal to noise, resolution, dynamic range) and analytical tools capable of dealing with such data, will make acoustic surveying a more realistic option.

Table 1 (a). Summary of acoustic abundance estimate data for cod in Placentia Bay, November 1995.

Placentia Bay East Block cod abundance, Nov. 1995

		Mean density (/sq.m.)	Block width (km)	Transect length (km)	Block length (km)	Fish# (transect)	Biomass (t - transect)
		Sum	Sum	Sum	Sum	Sum	Sum
Transect#	1	.0046	1.0	5.9	7.5	50941	122
	2	.0381	1.0	7.0	7.0	494616	1187
	3	.0139	1.0	7.2	7.5	187084	449
	4	.0041	1.0	7.2	7.5	55036	132
	5	.0129	1.0	9.4	9.5	224757	539
	6	.0001	2.0	7.9	8.0	4326	10
	8	.1786	2.0	4.6	8.5	3024553	7259
	9	.0667	1.0	7.6	10.0	940205	2256
	10	.0017	1.0	10.0	10.0	31487	76
	11	.0175	1.0	11.4	11.5	372642	894
	12	.0158	1.0	10.3	10.5	302786	727
	13	.0127	1.0	9.0	9.0	214073	514
	14	.0148	1.0	2.0	8.5	54212	130
	15	.0259	1.0	4.3	8.5	208945	501
	16	.0118	1.0	10.5	10.5	228668	549
	17	.0062	1.0	8.1	10.0	93131	224
	18	.0007	1.0	8.0	10.0	9851	24
	19	.0121	1.0	9.0	10.0	202733	487
Group Total		.4382	20.0	139.4	164.0	6700044	16080

Table 1 (b). Summary of acoustic abundance estimate data for cod in Placentia Bay, November 1995.

Placentia Bay West Block cod abundance, Nov. 1995

		Mean density	Block width (km)	Block length (km)	Transect length (km)	Fish# (transect)	Biomass (t - transect)
		Sum	Sum	Sum	Sum	Sum	Sum
Transect#	1	.0014	2.0	5	5.4	27334	66
	2	.0012	2.0	8	7.3	32660	78
	3	.0011	2.0	9	6.8	28080	67
	4	.0004	2.0	12	7.9	11284	27
	5	.0108	1.0	1	.5	9998	24
	6	.0094	1.0	1	.5	8772	21
	7	.0042	1.0	1	.5	3880	9
	8	.0558	1.0	1	.5	51891	125
	9	.2327	1.0	1	.5	216411	519
	10	.1194	1.0	1	.5	111052	267
	11	.3511	1.0	1	.5	326558	784
	12	.0901	2.0	12	7.0	2329312	5590
	13	.0001	2.0	14	8.7	4681	11
	14	.0115	2.0	14	8.4	360245	865
Group Total		.8892	21.0	81	55.1	3522161	8453

Fig. 1. Placentia Bay west block cod distribution, November 1995.

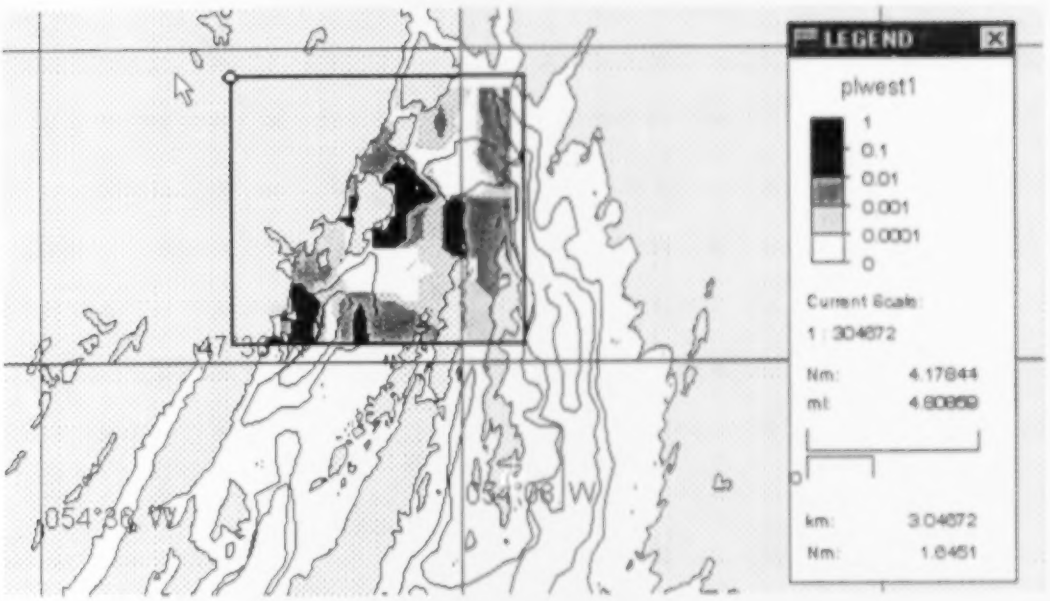


Fig. 2. Placentia Bay east block cod distribution, November 1995.

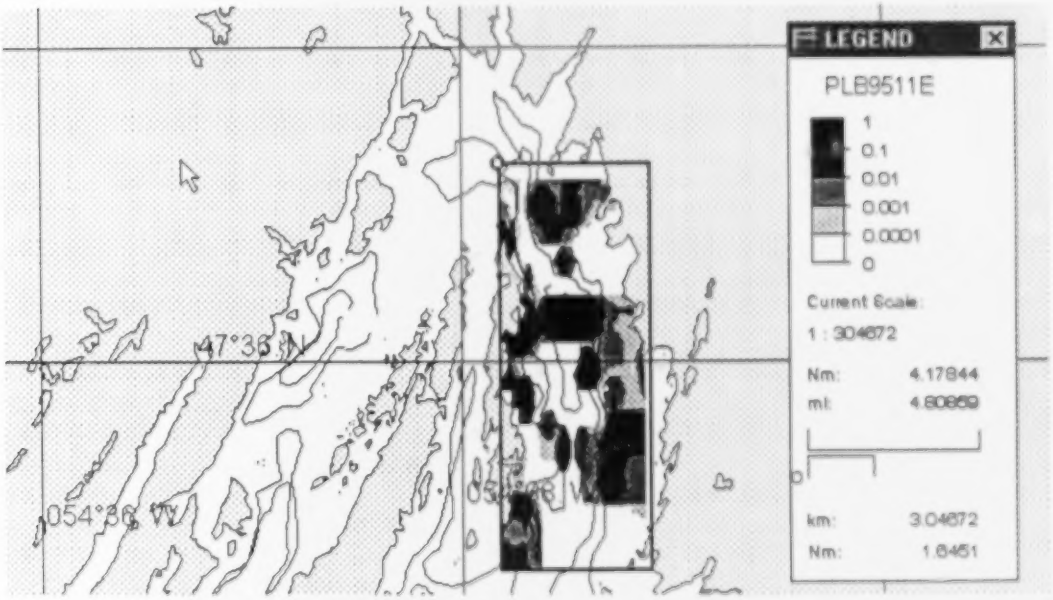
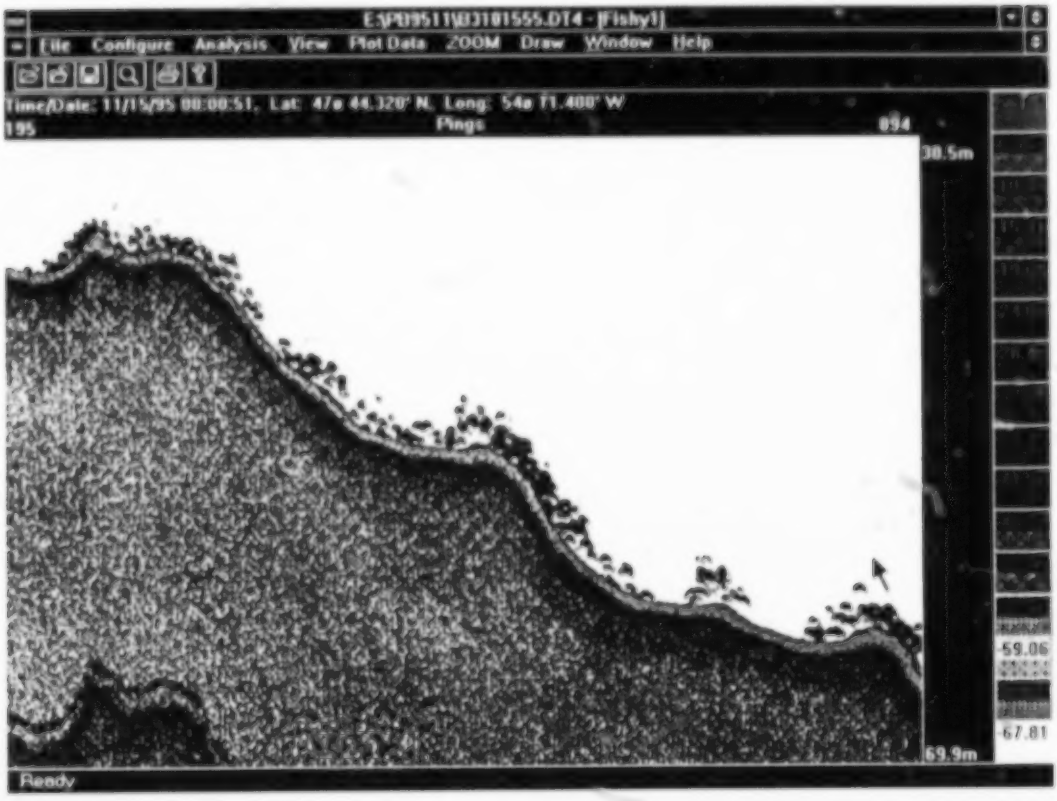


Fig. 3. Cod near bottom in sloping shallow waters of Placentia Bay in November 1995 as viewed with the FSIS software and analytical system.



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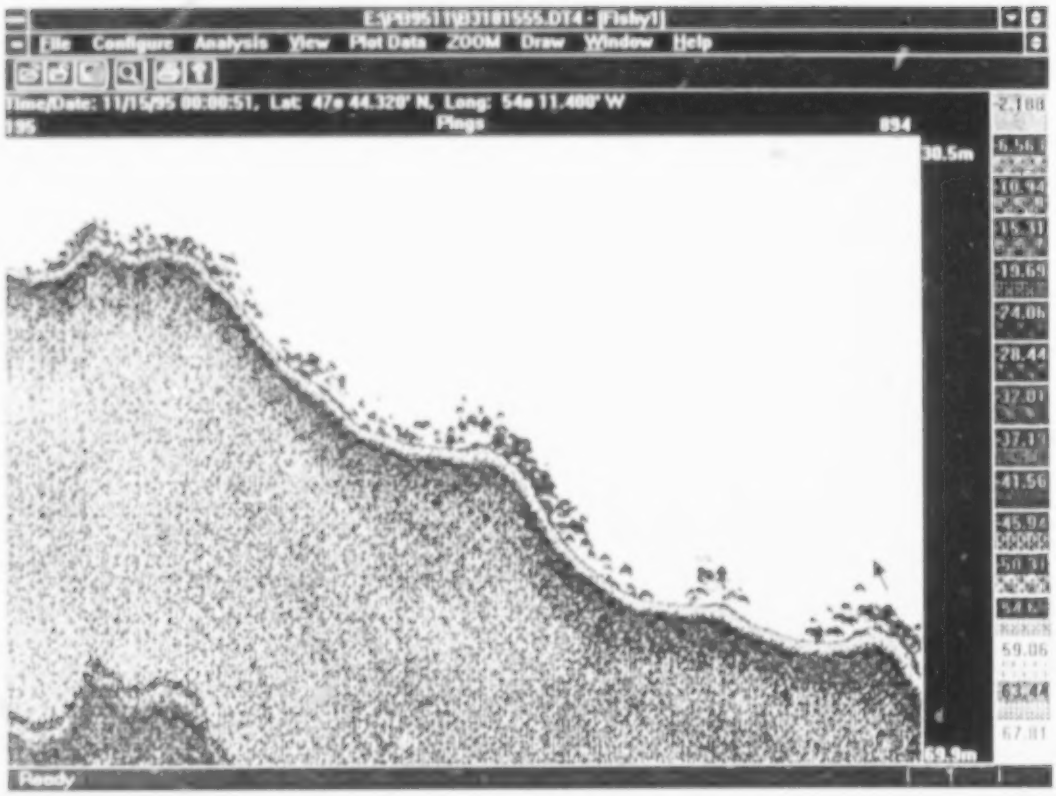
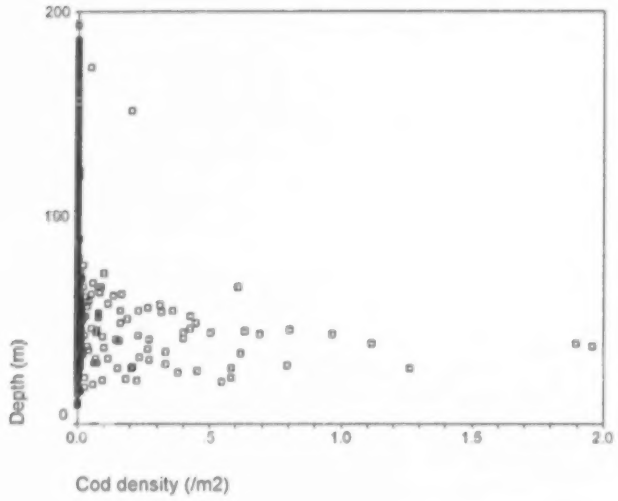


Fig. 4. Cod density relative to depth in Placentia Bay, November 1995.



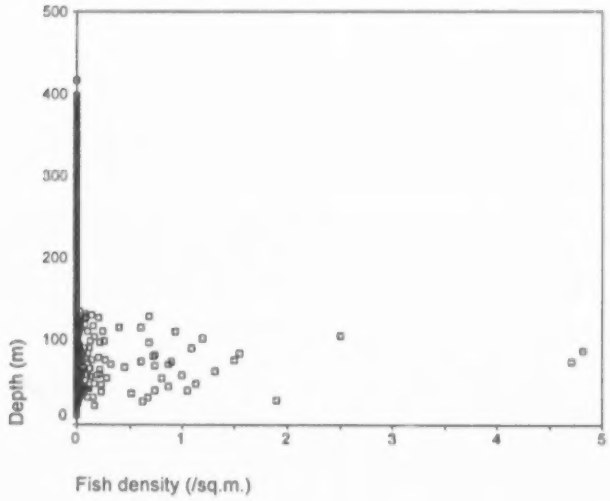


Fig. 5. Cod catch by automatic jig (2 reps/station).

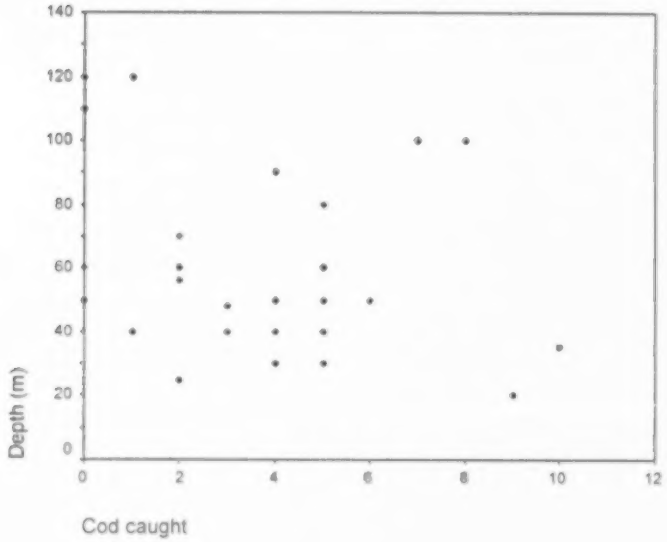


Fig. 6. Length and age of cod caught by automatic jigger in Placentia Bay, November 1995.